Emotion Telepresence: Emotion Augmentation through Affective Haptics and Visual Stimuli

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Emotion Telepresence: Emotion Augmentation through Affective Haptics and Visual Stimuli

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Abstract. The paper focuses on a novel concept of emotional telepresence. The iFeel_IM! system which is in the vanguard of this technology integrates 3D virtual world Second Life, intelligent component for automatic emotion recognition from text messages, and innovative affective haptic interfaces providing additional nonverbal communication channels through simulation of emotional feedback and social touch (physical co-presence). Users can not only exchange messages but also emotionally and physically feel the presence of the communication partner (e.g., family member, friend, or beloved person). The next prototype of the system will include the tablet computer. The user can realize haptic interaction with avatar, and thus influence its mood and emotion of the partner. The finger gesture language will be designed for communication with avatar. This will bring new level of immersion of on-line communication.

1. Introduction

Telepresence system allows a person to feel as if they were present at a place other than their true location. The sense of presence is provided with such stimuli as vision, hearing, sense of touch, etc. from a remote location [1][2][3].

Lobbard and Dutton concept can roughly be divided into two categories of presence: physical and social presence [4]. Physical presence refers to the sense of being physically located in mediated environment. While social presence implies the sense of social interaction with remotely located communication partner. We argue that the emotional telepresence, concept proposed by us, is the integral and one of the most important parts of feeling of being there.

Emotional telepresence, technology that lets users feel emotionally as if they were present and communicating at a remote physical location. The remote environment can be real, virtual, or augmented. Whereas conventional telepresence technologies focus on providing high-quality visual and audio feedback from the remote location to the user, emotional telepresence aims to enhance emotional immersion during online communication. In a nutshell, it ultimately aims to endow the online communicating partners with emotional experiences similar to those of face-to-face communication.

As the intersection of these categories, sense of co-presence combines the essential characteristics of emotional, physical, and social presence. The graphical representation of the relationship between all three main components is given in Figure 1.

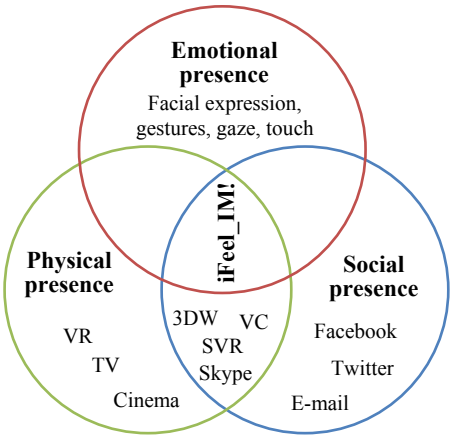

Figure 1. Relationship between physical, social, and emotional presence. Abbreviations are as follows: VR – virtual reality; 3DW – 3D worlds (e.g. SL, Sims); VC – video conferencing; SVR – shared virtual reality.

Conventional mediated systems usually:

- support only simple textual cues such as emoticons,
- lack visual emotional signals such as facial expressions and gestures,
- support only manual control of the expressiveness of graphical representations of users (avatars), and
- ignore such important social-communication channels as the sense of touch. Tactile interfaces could let users enhance their emotional-communication abilities by adding a new dimension to mobile communications.

Driven by the motivation to enhance social interactivity and emotionally immersive experience of real-time messaging, we proposed in the idea of reinforcing (intensifying) own feelings and reproducing (simulating) the emotions felt by the partner through specially designed system iFeel_IM!. The philosophy behind the iFeel_IM! (intelligent system for Feeling enhancement powered by affect sensitive Instant Messenger) is "*I feel* [therefore] *I am!*". The system employs haptic devices and visual stimulation to convey and augment the emotions experienced during online conversations [5]. It includes all three categories of the presence.

2. Architecture of the system

Figure 2 shows the structure of iFeel_IM! As you can see, the wearable part of the system is based on the human body and includes such parts as the heart, hands, abdomen, and sides.

iFeel_IM! stresses

- automatic sensing of emotions conveyed through text messages (artificial intelligence),
- visualization of the detected emotions through avatars in a virtual world,
- enhancement of the user's affective state, and
- reproduction of social touch through haptic stimulation in the real world.

We use Second Life as the communication platform. With Second Life, users can flexibly create their online identities (avatars) and play various animations (for example, facial expressions and gestures) of avatars by typing special abbreviations in a chat window.

We implement control of the conversation through EmoHeart, a Second Life object attached to an avatar's chest. EmoHeart communicates with the *Affect Analysis Model* (AAM), a system for textual affect sensing [6]. It also senses symbolic cues or keywords in the text that indicate a hug and generates a hugging visualization (that is, it triggers the related animation). iFeel_IM! stores the results from the AAM (the dominant emotion and intensity) and EmoHeart (the hug communicative function)

along with the chat messages in a file on each user's local computer.

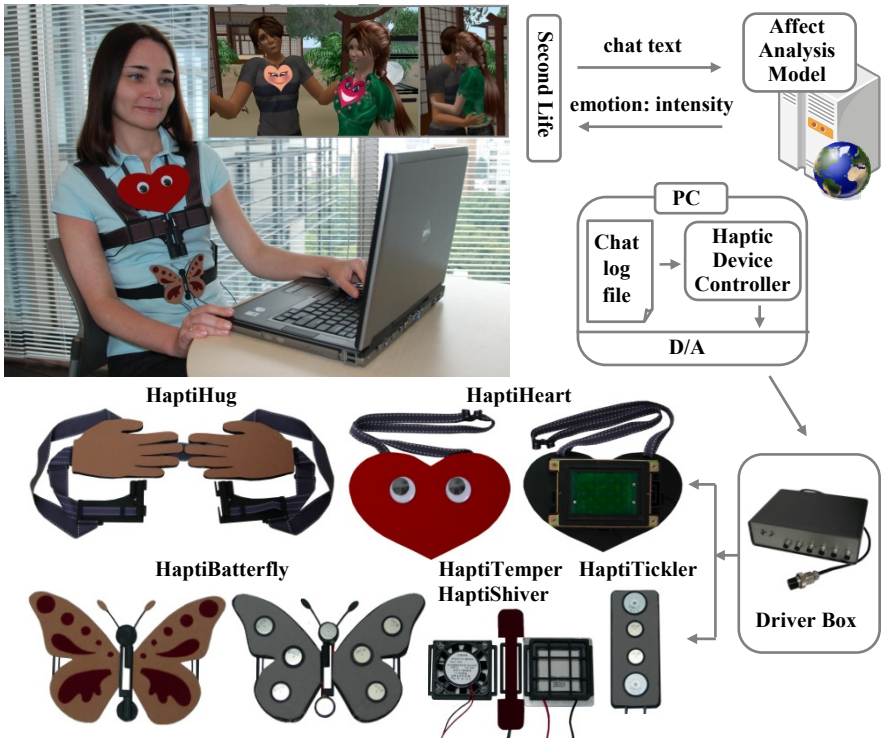

Figure 2. Architecture of the real-time communication system iFeel_IM!

The *haptic-device controller* analyzes the data in real time and generates control signals for the digital/analog converter, which then feeds control cues for the haptic devices to the *driver box*. On the basis of the transmitted signal, iFeel_IM! activates the user's corresponding haptic device. iFeel_IM! employs six haptic devices: HaptiHeart, HaptiHug, HaptiButterfly, HaptiTickler, HaptiTemper, and HaptiShiver.

3. User study

While demonstrating the iFeel_IM! system at the conferences, most of user reported that the haptic modalities (the simulated heartbeats, hugging, and tickling) produced highly realistic sensations. Subjects particularly enjoyed wearing HaptiHug; the simultaneous experience of the hugging animation and hugging sensation evoked surprise and joy. People who tried the system reported that the simulated heartbeats, hugging, and tickling were highly realistic.

The preliminary user study was carried out with six participants to evaluate the effectiveness of emotion elicitation and hug reproduction. The results revealed that the devices successfully generated the corresponding emotion (see Table 1, in which 100 percent stands for six positive replies). We assume that HaptiTemper would reinforce anger if it was activated along with HaptiHeart.

During the demonstration, we observed that HaptiButterfly and HaptiTickler induced most participants to smile and some of them to laugh. They expressed anxiety when HaptiHeart generated a fast, intense heartbeat pattern. The atmosphere between the participants and exhibitors was relaxed and joyful, indicating that iFeel_IM! successfully elicited emotions.

Table 1. Results of a six-user study evaluating the effectiveness of emotion elicitation and hug reproduction.

	Percentage of participants experiencing the emotion.			
Device	***Joy***	***Sadness***	***Anger***	***Fear***
HaptiHeart	—	83.3	66.7	100
HaptiButterfly	83.3	—	—	—
HaptiTickler	100	—	—	—
HaptiHug*	100	—	—	—

**100 percent of the HaptiHug users experienced social touch.*

4. Future work

The extensive user study on iFeel_IM! system will be conducted. We compare the iFeel_IM! system based on three different settings. The communication systems with emotional visual and haptic feedback, with only visual feedback, and without emotion enhancement (the textual communication) will be assessed. The following dimensions will be evaluated: (1) Interactivity, (2) Involvement (sense of co-presence), (3) Enjoyment, and (4) Overall satisfaction.

The novel robotic system with direct haptic avatar-mediated communication will be developed. The user wearing the affective haptic devises and holding tablet computer will interact with avatar by finger gestures (Figure 3(a)). The special gesture language will be designed to trigger the avatar (partner) emotions. The examples of basic touch gestures are given in Figure 3(b). User can hug the avatar by touching the surface with two fingers and bring them closer together. The heartbeat is generated through rapid touch of surface with fingertips. The time between consequent touches defines the frequency of the heartbeat. Tickling of avatar is driven by quick brushing of the surface with continuously engaging in the process fingertips. To make avatar feel afraid the user touches the surface by five fingertips continuously.

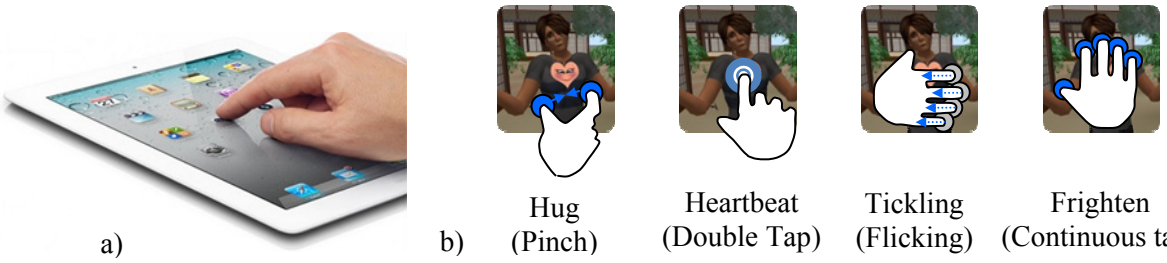

Figure 3. a) Tablet computer b) Basic touch gestures.

5. Discussion and conclusions

While developing the iFeel_IM! system (communication system with emotional telepresence), we attempted to bridge the gap between mediated and face-to-face communications by enabling and enriching the spectrum of senses such as vision and touch along with cognition and inner personal state.

In the paper we described the architecture of the iFeel_IM! and the development of a novel avatar-mediated communication system driven by touch gestures. The emotional brain of our system, Affect Analysis Model, can sense emotions and intensity with high accuracy. Haptic devices were designed with particular emphasis on natural and realistic representation of the physical stimuli, modular expandability, ergonomic human-friendly and emotional haptic design. User can perceive the intensive

emotions during online communication, use desirable type of stimuli, comfortably wear and easily detach devices from torso.

Our iFeel_IM! demonstrations resulted in keen discussions of possible applications for future research. Examples include

- treating depression and anxiety (problematic emotional states),
- controlling and modulating moods on the basis of physiological signals,
- affective and collaborative games, and
- psychological testing.

We believe that iFeel_IM! could greatly enhance communication in online virtual environments that facilitate social contact. It could also greatly enhance social life in terms of both interpersonal relationships and the character of community.

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